CHAPTER 9

CONSTRUCTION

9-1. Construction Survey.

a. The intent of the construction survey is to mark the route to guide construction. It may be done in two stages, especially in areas where significant amounts of earthwork and grading needed. In the first stage, enough mark are placed to define the basic track grade and drainage ditches. During this stage, culvert locations should be checked to ensure that final track elevation will allow room for sufficient cover over the culverts.

b. In the second stage, stakes are set for final grading and construction, including spiral and curve locations, grade and side slope markers, bridge abutments, culvert centerlines, and frog and switch point locations for turnouts. It is best to set stakes only a short time before they will be needed, to minimize the chances of them being disturbed. Guidance on stake setting is given in table 9-1.

Table 9-1. Suggested Stake Intervals for Final Survey

Track Category	Suggested Stake Interval (feet)
Tangents	100
Curves: up to 3 degrees	100
3 to 6 degrees	50
over 6 degrees	25

9-2. Inspecting Materials.

a. Inspect Before Installation. It is recommended that all materials (new or secondhand) be inspected before work begins. If there are question concerning the materials, it is much better to handle them before the material has been installed.

b. Ties. Although inspection of the ties at the plant is preferred, this is not always possible However, upon delivery to the project site, all ties will be inspected to ensure compliance with the project specifications. Ties not meeting the specifications will be rejected. The inspector should receive a copy of the treatment report from the treatment plant and check that a date and manufacturer's brand are present on the ties.

c. Relay Rail. When relay rail is bought for the project, it will be inspected for wear and external defects (end batter, engine burns, etc.), per the project specifications. Standard gages are available for checking wear.

9-3. Saving Salvageable Materials.

a. When removing rail and other track material (OTM) for stockpile at an installation or transfer to another installation, rail of like weight and section (and OTM of like size and design) should be stacked neatly together. Normally, spikes will not be salvaged.

b. Care should be taken when removing rail and OTM to prevent damage to usable materials. A torch should never be used to cut rail, joint bars or other salvageable materials during removal.

9-4. Subgrade and Drainage.

a. Subgrade. The subgrade will be inspected during each stage of preparation.

b. Handling and Installing Geotextiles.

(1) The maximum time for exposure of geotextiles to sunlight, from removal of the protective shipping cover to final placement, should be no more than seven days.

(2) Equipment should not be allowed to operate over an area covered with geotextile unless there is at least a 6-inch cover of sub-ballast or ballast.

(3) Surface drainage should be directed away from geotextile material to help prevent contamination.

(4) The minimum overlap distance in the longitudinal and transverse directions should be 3 feet.

c. Drainage.

(1) Drainage and other earthwork near the track should be completed before final subgrade preparation begins; this minimizes the likelihood of disturbing the final subgrade surface or getting soil in the ballast, and also provides a properly draining work site.

(2) Subdrainage installations should be checked before being covered and ditch elevations and sections checked before track work begins.

9-5. Track Construction.

a. Sub-ballast Placement.

(1) On new construction, the subgrade surface should be inspected before geotextile or sub-ballast the is placed.

(2) Sub-ballast is placed on the prepared subgrade and compacted to provide a working surface for track construction. Sub-ballast should be placed to the lines of grade shown on the

project plans and compacted to 95 percent of ASTM D 1557 laboratory maximum dry density.

b. Track Construction Sequence. Typical track construction sequence is as follows:

(1) Place ties on the sub-ballast at the required spacing.

(2) Place tie plates on the ties.

(3) Place the line rail on the tie plates and spike in place.

(4) Install joint bars and tighten bolts.

(5) Install the opposite rail by first checking the gage and spiking every fourth tie and then spiking the remaining ties.

(6) Install rail anchors at this stage, or after final surface (but before dressing ballast).

(7) Unload and distribute ballast.

(8) List and tamp track to about 1 inch below final elevation, in 3-4 inch lifts, adding ballast as needed after each lift. The tamping machine will also align the track and place the proper superelevation in the curves during this operation.

(9) Check grade and line stakes, and clearances.

(10) If practical, run over track with at least 10 passes of an engine (or engine with heaviest loaded cars) before the finial surface.

(11) Raise track to final surface.

(12) Dress (shape) ballast section.

c. Ballast Unloading.

(1) Large amounts of ballast (several hundred tons or more) are most efficiently unloaded using railroad hoppers. For installations having a loco motive, the provision of a government locomotive and crew to move the ballast cars for the contractor may result in a lower unit cost for ballast distribution. Appropriate arrangements should be provided in the contract documents and during the preconstruction meetings to insure effective use of government locomotive to assist the contractor in racing the ballast.

(2) When trucks or other automotive equipment are used to place ballast, care should be taken to prevent rutting that would impair drainage of the sub-ballast or subgrade. Any ruts that are formed should be leveled and graded to drain prior to the continuation of ballast placement.

d. Rail Installation.

(1) Rails should be laid one at a time with allowance for expansion provided between the rail ends in accordance with table 9-2.

(2) Gaps between rail ends and insulated joints should only be sufficient to permit insertion of standard end posts.

(3) During rail laying a standard rail thermometer should be used to determine the rail temperature. The thermometer should be laid close to the web on the side of the rail base which is shaded from the sun, in advance of the laying operation and left there long enough to accurately record the temperature.

e. Installing Relay Rail.

(1) When relay rail is used, care should be exercised in matching adjacent rails to minimize joint mismatch. Any mismatch at the rail ends

Table 9-2. Rail Joint Gap.

Rails up to 33 feet long		**Rails 39 feet to 160 feet long**	
Rail Temperature (Fahrenheit)	**Rail End Gap**	**Rail Temperature (Fahrenheit)**	**Rail End Gap**
Below -10	5/16	Below 6	5/16
-10 to 14	1/4	6 to 25	1/4
15 to 34	3/16	26 to 45	3/16
35 to 59	1/8	46 to 65	1/8
60 to 85	1/16	66 to 85	1/16
Over 85	None	Over 85	None

must be ground or welded to provide proper match. Building up a worn end by welding may only be done by people with the proper training, experience, and equipment to perform this operation.

(2) Relay rail will be laid with the previous gage side facing out (old field side becoming the new gage side) unless required to match existing wear patterns. Where either overflow or a nearly square edge is left on the new gage side, this edge must be ground to a rounded profile-similar to that found on new rail.

f. Surfacing and Lining.

(1) During the surfacing operation, every tie should receive two full insertions of the tamping heads at each lift. The joint ties, on the joint side only, should get an additional insertion.

(2) If raising the track creates voids under the tie centers, the void space should be filled lightly but not tamped.

(3) Worn tamping feet on a tamping machine will not properly compact ballast under the ties.

(4) Ties which pull loose during surfacing should be lifted and plugged or replaced, spiked or retamped.

(5) Track at the ends of open deck bridges should be maintained at the same grade as the track on the bridge for at least 25 feet beyond bridge abutments and then transition smoothly to meet established track grades.

(6) Track should not be tamped if snow cover is present or in frozen ballast conditions.

g. Switch Stand Installation. The switch stand is normally installed so that when the switch is lined for the normal (main) route, the connecting rod keeps the point closed with a pulling (rather than a pushing) force. In most cases, this will mean installing the stand on the diverging side of the turnout. When a ground throw stand is used, the handle should point toward the frog when the switch is lined for the normal route.

9-6. Quality Control/Quality Assurance

a. Many installations and offices do not have inspectors who are knowledgeable and experienced in railroad work. In these cases it is strongly recommended that inspection services be obtained from an engineering firm which specializes in railroad design and construction.

b. As initial work is often covered over in final stages, it is storngly recommended that railroad work be inspected throughout the process.

c. All relay rail should be ultrasonically tested after installation. Scheduling with a contractor specialized in this operation should be done well in advance to assure availability at the least cost.

9-7. As-Built and Final Drawings.

Upon completion of construction, a set of red-line drawings should be given to the installation engineer. Final as-built drawings will be produced showing the actual track locations, grades, curvatures and complete curve data, rail weight and section, grade corssing locations and types, crossing signal circuitry and layout, drainage structures, and other aspects of track construction. These drawings will be given to the installation engineer within six months after construction has been completed.